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AUXILIARY SUPPORTING UNIT, BOARDING BRIDGE WITH THE SAME AND METHOD FOR IMPROVING STABILITY OF THE BOARDING BRIDGE BY USING THE SAME

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AUXILIARY SUPPORTING UNIT, BOARDING BRIDGE WITH THE SAME AND CONTROL METHOD FOR THE BOARDING BRIDGE

FIELD OF THE INVENTION

The present invention relates to an auxiliary supporting unit used for a passenger boarding bridge, it also relates to a boarding bridge with the same and method for controlling the boarding bridge, particularly to an adjustable auxiliary supporting unit, a boarding bridge with improved stability and reliability as well as a control method for the boarding bridge.

BACKGROUND OF THE INVENTION

The passenger boarding bridge as a kind of equipments used in airport is very popular due to its convenience and security. The boarding bridge assists the passenger to go aboard an airplane directly from a terminal building. At present, many kinds of passenger boarding bridges are disclosed, such as in Chinese patent No. ZL95226673.3, ZL00258374.7 and American patent No. US5855035. Conventionally, there are two manners for supporting a beam of boarding bridge, which is respectively named a single-point supporting and a double-point supporting. With reference to Fig. 1, a passenger boarding bridge 100 in so-called single-point supporting manner is disclosed in Chinese Patent ZL00258374.7, which comprises a rotunda connected to a terminal (not shown), a tunnel 101 which can be retracted or extended to change its length, elevation system used for adjusting the height of the tunnel 101, a wheel mechanism 102 for supporting the tunnel 101 through the elevation system etc. The wheel mechanism 102 is provided with two wheels attached respectively to both ends of a beam. A bearing plate is substantially located

in the center of the beam and used for supporting the elevation system. However, the bridge 100 according to the manner of supporting has poor stability, as the tunnel 101 are often wobbling when it carries the passengers or when the wheel mechanism 102 is driven to move or turn around the bearing plate. Chinese patent ZL95226673.3, as shown in Fig. 2, discloses another bridge 200 with a wheel mechanism 201 for supporting an elevation system 203 which can adjust or control a tunnel 202 to change its height. Now referring to Fig. 2 and Fig. 3, specially, two sets of wheel assembly 204 are attached to both ends of a beam 301 to improve the stability of the bridge 200, each set of which further comprises a revolving base 302 used for supporting, a hinge support 303 and a hinge shaft 304, and two wheels 305. Importantly, for this kind of bridge 200 in so-called double-supporting manner, a synchronous steering mechanism 307 is necessary in order to drive the wheel assembly 204 at two ends of the beam 301 to move and rotate, or a control system is alternatively utilized to drive the wheel 305 in order to accomplish synchronous moving and/or rotation of the wheel 305. In fact, the conventional boarding bridge 200 according to the double-supporting manner is more stable than before, while it has a complex structure and a low safety, and the control system for synchronous operation of the wheels are even more complicated and expensive. Furthermore, the reliability of the bridge is deduced accordingly as it is unavoidable for the control system to break down.

SUMMARY OF THE INVENTION

One object of the present invention is to provide an auxiliary supporting unit for a boarding bridge. The auxiliary supporting unit is mounted under two ends of a beam of a wheel mechanism in order to provide auxiliary support to the boarding bridge, thereby the stability of the boarding bridge is increased.

Another object of the present invention is to provide a boarding bridge with an auxiliary supporting unit and a method for improving the stability of the boarding bridge.

The above object of the present invention is realized by providing an auxiliary supporting unit mounted under two ends of the beam, comprising a leg support the and a foot portion, a first end of the leg support being connected to the beam and a second end of the leg support being connected to the foot portion, whereby the foot portion of the auxiliary supporting unit is movable on or slightly above the ground to provide an auxiliary support to the beam and the boarding bridge thereon.

In the above-mentioned auxiliary supporting unit, the foot portion is a universal wheel.

In the above-mentioned auxiliary supporting unit, a buffer is further provided between the leg support and the foot portion.

In the above-mentioned auxiliary supporting unit, a manual mechanism is provided for driving the foot portion.

In the above-mentioned auxiliary supporting unit, a power-driven thruster having a fixed part and a moving part is provided for driving the foot portion.

In the above-mentioned auxiliary supporting unit, the foot portion is configured into a supporting seat.

In the above-mentioned auxiliary supporting unit, the foot portion is a universal wheel.

In the above-mentioned auxiliary supporting unit, the moving part of the leg support is connected to the supporting seat via a hinge.

In the above-mentioned auxiliary supporting unit, the power-driven thruster is a hydraulic cylinder or an electrical thruster.

Another object of the present invention is realized by providing a boarding bridge comprising a tunnel disposed above a beam, the first end of the tunnel being connected to a boarding gate of an airport and the second end of the tunnel being connected to an exit of an airplane; an elevator system provided at the another end of the tunnel being connected to the exit of the airplane; a wheel mechanism provided with a beam, a supporting unit composed of a revolving base, a hinge support and a hinge shaft being provided thereon, wheels, attached to the supporting unit and rotating relative to the revolving base; a control system, for controlling the moving direction of the wheels and the lifting of the elevator system; wherein the boarding bridge further comprising an auxiliary supporting unit, defined under two ends of the beam and provided with a leg support and a foot portion, the first end of the leg support being connected with the beam and the second end of the leg support being connected with the foot portion, the foot portion being movable on or slightly above the ground to provide an auxiliary support to the beam and the boarding bridge thereon.

In the above-mentioned boarding bridge, the foot portion is a universal wheel, the first end of the leg support is mounted under the beam and the second end of the leg support is connected to the universal wheel.

In the above-mentioned boarding bridge, a buffer is further provided between the leg support and the foot portion.

In the above-mentioned boarding bridge, the leg support is a power-driven thruster, which has a fixed part mounted under the beam and a moving part connected to the foot portion.

In the above-mentioned boarding bridge, the foot portion is configured into a supporting seat.

In the above-mentioned boarding bridge, the foot portion is a universal wheel.

In the above-mentioned boarding bridge, the moving part of the power-driven thruster is connected to the supporting seat via a hinge.

In the above-mentioned boarding bridge, the power-driven thruster is a hydraulic cylinder or an electrical thruster.

In the above-mentioned boarding bridge, an angle detector is in coaxial connection with the bearing assembly for measuring an angle of wheel mechanism turned relative to a longitudinal axis.

In the above-mentioned boarding bridge, the foot portion is driven to extend to be supported on the ground with a pressure by adjusting the leg support of the auxiliary supporting unit.

Another object of the present invention is realized by providing a method for controlling the boarding bridge, comprising steps of:

1) providing a wheel mechanism, which has a beam on which a supporting unit including a revolving base, a hinge support and a hinge shaft is provided; and wheels attached to the supporting unit and rotating relative to the revolving base, used for driving the boarding bridge;

2) providing a tunnel disposed on the beam, for connecting a boarding gate with an exit of an airplane;

3) providing an elevation system for lifting the tunnel to connect with the exit of the airplane;

4) providing a control system for controlling the moving direction of the wheel mechanism and the lifting of the elevation system; and

5) providing an auxiliary supporting unit, mounted under two ends of the beam,

the auxiliary supporting unit comprising a leg support and a foot portion, a first end of the leg support being connected to the beam and a second end of the leg support being connected to the foot portion; whereby the foot portion of the auxiliary supporting unit is movable on or slightly above the ground to provide an auxiliary support to the boarding bridge by adjusting the leg support under the control of the control system so as to balance torsion forces of the boarding bridge when the boarding bridge is moving.

In the above-mentioned method, the foot portion of the auxiliary supporting unit is a universal wheel.

In the above-mentioned method, a buffer is further provided between the leg support and the universal wheel, whereby the foot portion of the auxiliary supporting unit is supported on the ground to provide an auxiliary support to the boarding bridge by the buffer so as to balance torsion forces of the boarding bridge when the boarding bridge is moving.

In the above-mentioned method, the leg support of the auxiliary supporting unit is a power-driven thruster, and the foot portion is a supporting seat, whereby when the boarding bridge moves to connect with the boarding gate of the airplane, the supporting seat is driven by the power-driven thruster to extend to support on the ground in a given pressure, so as to provide an auxiliary support to the boarding bridge, and when the boarding bridge needs to move again, the supporting seat is retracted by the power-driven thruster under the control of the control system to the original status.

In the above-mentioned method, the leg support is a power-driven thruster and the foot portion is a universal wheel, whereby the universal wheel driven by the power-driven thruster extends to be supported on the ground under the controlling of the control system in a given pressure, so as to balance torsion forces of the boarding bridge during the moving of the boarding bridge and make the boarding bridge stable.

In the above-mentioned method, an angle detector is provided on the beam to measure an angle of the wheels relative to a longitudinal axis of the boarding bridge and send the detected angle signal to the control system of the boarding bridge, whereby the leg support is driven to extend or retract by the power-driven thruster in a given pressure under the controlling of the control system in response to the detected angle signal.

In the above-mentioned method, when the detected angle is lager than a first predetermined value α, the foot portion is driven by the power-driven thruster under the controlling of the control system of the boarding bridge to extend out to be supported on the ground in a given pressure so as to increase the stability of the boarding bridge; when the detected angel is smaller than a second predetermined value β, the foot portion is driven by the power-driven thruster to retract to its original status; and when the detected angle is larger than the second predetermined value β and smaller than the first predetermined value α, the power-driven thruster is idle under the control of the control system of the boarding bridge.

In the above-mentioned method, the first predetermined value α is larger than the second predetermined value β.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described in details with accompanying drawings and preferred embodiments, which however, won't be used as a limitation to the invention.

Fig. 1 is a perspective view of a conventional boarding bridge, showing that a wheel mechanism supports an elevation system in a manner of single-point supporting;

Fig. 2 is a perspective view of another conventional d boarding bridge, showing

that a wheel mechanism supports an elevation system in a manner of double-point supporting;

Fig. 3 is an enlarged cross-sectional view of the wheel mechanism 201 of Fig. 2;

Fig. 4 is a schematic view of the wheel mechanism with an auxiliary supporting unit according to a first embodiment of the present invention;

Fig. 5 is a schematic view of the wheel mechanism with an auxiliary supporting unit according to a second embodiment of the present invention;

Fig. 6 is a schematic view of the wheel mechanism with an auxiliary supporting unit according to a third embodiment of the present invention;

Fig. 7 is a side view of the auxiliary supporting unit as shown in Fig. 6;

Fig. 8 is a schematic view of the wheel mechanism with an auxiliary supporting unit according to a fourth embodiment of the present invention;

Fig. 9 is a side view of the auxiliary supporting unit as shown in Fig. 8; and

Fig. 10 is a schematic view of the wheel mechanism showing angles that the wheel mechanism is driven to rotate.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A wheel mechanism as one of major components of a passenger boarding bridge has been improved by the inventors and will be discussed further on in this specification.

Referring to Fig. 4, a wheel mechanism 10 according to the first embodiment of the present invention used for passenger boarding bridge (not shown) comprises a beam 2, on which an elevator system for adjusting a tunnel of the bridge (not shown) is provided; a wheel assembly 1 coupled with a bearing assembly to further support the beam 2, being driven by a control system and allowing the bridge 10 to be driven up to the airplane, and

auxiliary supporting units 20 which are further attached to both ends of the beam 2 in order to provide auxiliary support to the beam 2 and the tunnel through the elevation system.

The auxiliary supporting unit of the present invention includes a leg support mounted to the beam and foot portion attached thereon. The leg support can be adjusted to retract or extend under a predetermined condition.

The extension or retraction of the leg support of the auxiliary supporting unit according to the invention may be realized by providing a power-driven mechanism thereon, such as a hydraulic cylinder or an electrical thruster, or by providing a manual mechanism which is for example similar to the structure of a mechanical lifting jack comprising a screw bolt and a screw nut. That is, one end of the lifting jack is connected to the beam and the other is connected to the foot portion, whereas the extension length of the leg support is adjustable in a screw driven manner. In addition, a manual pump, or a mechanism such as a rod with two flanges at opposite ends thereof can be used for the invention, whereby the length of the leg support can be adjusted by adding adjusting washers or wedge blocks.

Now the structure of the auxiliary supporting unit will be described in detail hereinafter with reference to embodiments of the present invention.

Embodiment 1:

Fig. 4 is a schematic view of a first preferred embodiment of the auxiliary supporting unit in accordance with the present invention. The wheel mechanism 1 is provided on a center of the beam 2 through the bearing assembly. A pair of the auxiliary supporting units 20 are defined outside the wheel mechanism 1 and respectively mounted under both ends of the beam 2 in order to support the beam 2. Each unit 20 comprises a leg support 23 attached under the beam 2 and a foot portion 25. The leg support 23 can be

driven by the control system to retract and extend, whereas the foot portion 25 may leave the ground under a predetermined condition while retracting the leg support 23 and may be alternately supported on the ground while extending the leg support 23. As the foot portion 25 may be stepped on the ground, the foot portion 25 according to the preferred embodiment of the invention shall be configured into universal wheels.

Preferably, the auxiliary supporting unit is configured to keep a gap between the ground and the universal wheel (foot portion) 25. The universal wheel (foot portion) 25 will depend on the ground and support the boarding bridge through the beam and prevent the boarding bridge from wobbling or slanting when a slight tilting occurs during the moving of the boarding bridge or carrying the passengers.

Embodiment 2:

Now referring to Fig. 5, a second preferred embodiment of the auxiliary supporting units 20 are also provided outside the wheel mechanism 1, each of which is mounted under one end of the beam 2 in order to support the beam 2. The unit 20 comprises a leg support 33 attached under the beam 2 and a foot portion 35. The leg support 33 can be driven by the control system to retract and extend, whereas the foot portion 35 is also configured into a universal wheel in order to step on the ground. Preferably, the foot portion 35 of the preferred embodiment is attached to the leg support 33 through a buffer 34.

However, the surface of ground of an airport is always uneven, the buffer 34 is advantageously utilized to ensure the universal wheel 35 being supported on the ground at a pre-pressure in order to balance torsion forces due to the slope of the boarding bridge and improve the stability of the boarding bridge. In this case, the pre-pressure at one side of the beam 2 will be a constant value once the boarding bridge is located, but will be changed within a predetermined range when the boarding bridge being moving. .

Embodiment 3:

Figs. 6-7 shows a third embodiment of a pair of auxiliary supporting units 20 which are also provided outside the wheel mechanism 1. Each unit 20 is mounted under one end of the beam 2 in order to support the beam 2, comprising a leg support 3 attached under the beam 2 and can be driven by the control system to retract and extend, and a foot portion 5 supported on the ground. In this embodiment, the leg support 3 is a power-driven thruster, which has a fixed part 31 mounted under the beam 2 and a moving part 32 connected to the foot portion5. The foot portion 5 is configured into a supporting seat coupled to the leg support 3 in manner of hinge joint. For example, a hinge 4 may be provided for connecting the supporting seat to the leg support 3. Alternately, the supporting seat 5 may be coupled to the leg support 3 directly.

When the boarding bridge is located on a certain position, the supporting seat 5 is driven by the control system of the boarding bridge to be supported on the ground with a pressure. The pressure makes the boarding bridge more stable by balancing the torsion forces presented when carrying passengers. When the boarding bridge starts to move again, the supporting seat 5 will be retracted to its original status.

Embodiment 4:

Figs. 8-10 show a fourth embodiment of an auxiliary support unit 20. The structure of the auxiliary support unit 20 according to the preferred embodiment is substantially as same as that of the first embodiment except for an angle detector 11 which will be described in detail hereinafter.

For Example, each unit 20 is mounted under one end of the beam 2 in order to support the beam 2, comprising a leg support 13 attached under the beam 2 and can be driven by the control system to retract and extend, and a foot portion 15 supported on the

ground. In this embodiment, the leg support 13 is a power-driven thruster, which has a fixed part 131 mounted under the beam 2 and a moving part 132 connected to the foot portion 15. The foot portion 15 is configured into a universal wheel coupled to the leg support 13.

The angle detector 11 is preferably in coaxial connection with the bearing assembly 21 provided on the beam 2 in order to measure the angle for the wheel mechanism 1 rotating relative to the longitudinal axis of the boarding bridge. For example, the angle detector 11 may be a potentiometer etc. The angle signals detected by the detector 11 are sent to the control system of the boarding bridge.

Especially, a method of controlling the auxiliary support unit of the present invention will be explained further on.

Firstly, the control system may receive signals transferred from detector 11 in relation with a direction and angle as long as the wheel mechanism 1 of the boarding bridge starts to move.

Then, the control system can judge according to the detected angle signals whether the boarding bridge is in stable condition and then can drive the leg support to be extended or retracted if not.

When the detected angle θ is larger than a first predetermined value α, the auxiliary support unit of the present invention can be driven by the control system to extend until the foot portion is supported on the ground with a pressure so as to balance the torsion forces of the boarding bridge, thereby the stability of the boarding bridge is increased. When the detected angel θ is smaller than a second predetermined angle β, the auxiliary support unit of present invention is driven to retract until the foot portion leaves the ground to reduce friction between the ground and the foot portion and also to reduce the consumption of foot portion so as to increase its life span. When the detected angle is larger than the angle β

and smaller than the angle α, the leg support of the invention is under an inactive status. The angle α should be configured to be larger than the angle β according to the invention in order to avoid the leg support from being extended or being retracted frequently when the bridge movers into the area where an angle the wheel mechanism turned is larger than angle β but smaller than angle α.

It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only. Changes may be made in details, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

INDUSTRIAL APPLICABILITY

According to the present invention, the auxiliary supporting unit has a simple structure and is easy to be manufactured, installed and adjusted. Advantageously, the auxiliary supporting unit of the present invention can also be easily installed on the conventional single-point boarding bridge, so as to reduce the slant and wobbling of the boarding bridge and enhance the stability of the boarding bridge.

According to the control method of the present invention, the power-driven thruster can be easily controlled to keep the stability of the boarding bridge.